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Preliminary Design and Initial Testing of a Mobile Electrostatic Precipitator

Southern Research Inst, Birmingham, Ala

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Industrial Environmental Research Lab, Research Triangle Park, N C

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United States
Environmental Protection
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Industrial Environmental Research
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Research Triangle Park NC 27711

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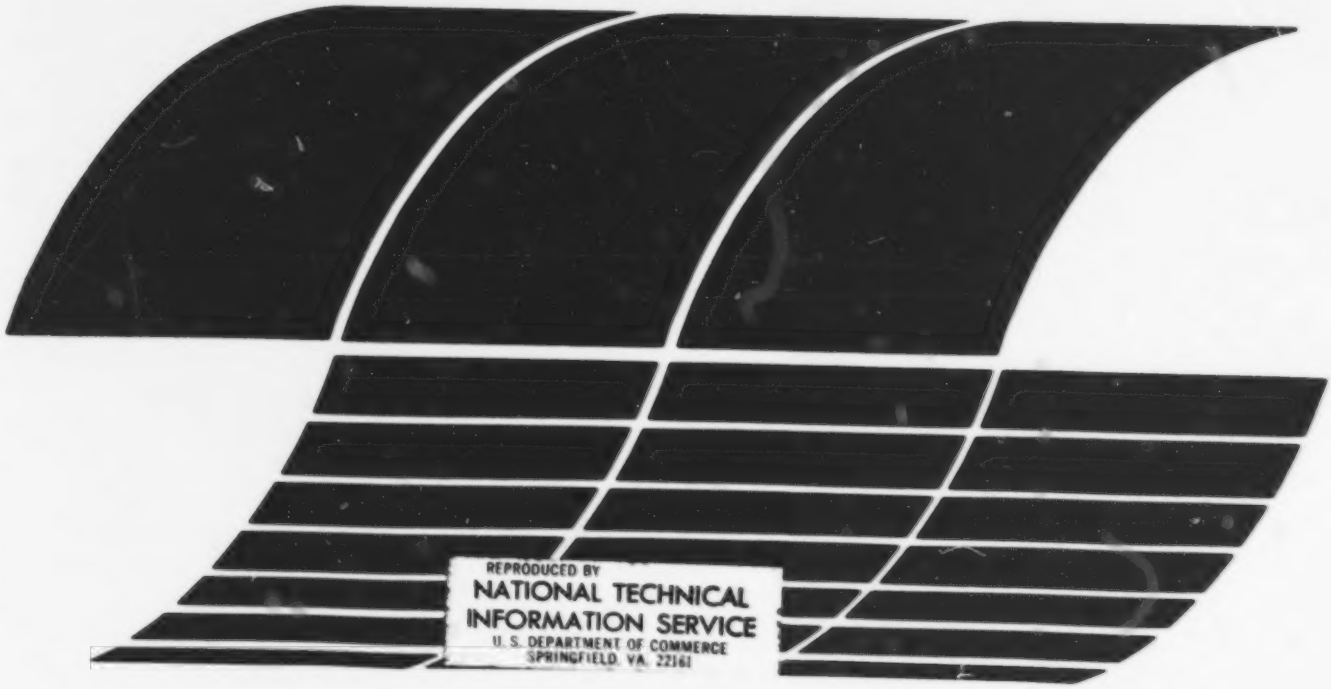
EPA

Preliminary Design and Initial Testing of a Mobile Electrostatic Precipitator

Interagency Energy/Environment R&D Program Report



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Preliminary Design and Initial Testing of a Mobile Electrostatic Precipitator

by

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Contract No. 68-02-1860
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Prepared for

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ABSTRACT

This report describes the factors considered and the general design concepts of a mobile electrostatic precipitator. This pilot scale device is one of a family of laboratory scale control deivces utilized by the Industrial Environmental Research Laboraoty of the U. S. Environmental Protection Agency located at Research Triangle Park, N. C. The final design and construction of the unit was provided by the Naval Surface Weapons Center at Dahlgren, Virginia.

TABLE OF CONTENTS

	Page
Figures	iii
Tables	iv
Section I Introduction	1
Section II Discussion	2
Section III Field Evaluation	10
Section IV Design Of Additional Items	11
Appendix I Design Drawings For Use By - Naval Surface Weapons Center for the Mobile Electrostatic Precipitator	14-26
Appendix II Pilot Electrostatic Precipitator Operating Guide	27-31

FIGURES

Number		Page
1	Sodium carbonate injection system for E.P.A. pilot E.S.P.	12
2	300 cfm cyclone with a D_{50} of 5 microns	13

TABLES

Number		Page
I	Comparison Of Pilot And Full Scale Electrostatic Precipitator Parameters.....	4
II	Mobile Pilot Electrostatic Precipitator Shakedown Tests NERC Laboratories.....	7
III	Mobile Electrostatic Precipitator Tests.....	8

SECTION I

INTRODUCTION

This report summarizes the work performed under Contract 68-02-1860 to provide the general design and assistance in the evaluation of a mobile electrostatic precipitator. This test facility was constructed for the Industrial Environmental Research Laboratory of the U. S. Environmental Protection Agency at Research Triangle Park, North Carolina, by the Environmental Sciences Branch, of the Naval Surface Weapons Center at Dahlgren, Virginia.

The mobile electrostatic precipitator test facility was designed to assist the Industrial Environmental Research Laboratory in evaluating the applicability of the E.S.P. to a variety of industrial applications. The test facility design included both a pilot scale electrostatic precipitator and a laboratory van. The two units comprise a self sufficient facility with the exception of the requirements for external sources of electrical energy and water.

SECTION II

DISCUSSION

Southern Research Institute was directed to supply a conceptual design for the mobile test facility and to provide assistance to the E.P.A. during the construction and test of the unit. These services were provided as needed during the period of time that the contract was active. The guidelines for this contract specified in the scope of work were:

1. Mobile unit mounted on trailer suitable for highway travel
2. Three inlet and outlet sampling sites included
3. Minimum of four independent electrical sections
4. Secondary voltage and current meters required
5. Operation up to temperature of 480°C
6. Fans and strip heaters to be included
7. Variable intensity rappers required
8. Include optical instrumentation port
9. Provide guidance in design of data sheet
10. Design 300 cfm cyclone with a D_{50} of 5 microns
11. Include gas flow control devices.

In addition the following items were to be considered for inclusion if practical:

1. Lighted view ports in outlet section
2. Utilize standard E.S.P. electrical insulators
3. Wet and dry operation
4. Variable collection electrode spacing
5. Use precipitator vehicle for laboratory van.

The items in the second group were to serve as suggestions for the Naval Surface Weapons Center in the design of the unit, of these, only the view ports were actually incorporated into the final design of the unit.

The initial design for the electrostatic precipitator was transmitted to the Environmental Protection Agency and the Naval Surface Weapon Center on September 24, 1974. The drawings, reduced and included as Appendix I of the report, served as a conceptual design for the pilot precipitator. The Naval Surface Weapon Center developed the final design of the mobile E.S.P. from these suggestions. Meetings were held between the individual parties at Research Triangle Park, Naval Surface Weapons Center and Southern Research Institute, during the design phase for this mobile test facility.

A number of problems were encountered during the development of the device. Electrical sparkover between the corona wire support system and grounded portion of the system occurred. Similarly, electrical sparking occurred from the point that the high voltage connecting is made to the corona frame. These problems were solved during visits to the Naval Surface Weapon Center.

The power supplies that were delivered from Peschel Instruments also required some modifications. Even though the required voltage and current were stated to meet the specified values when connected to a resistive load, they did not when connected to the corona frame. These problems were corrected by the manufacturer when the transformers were returned.

The design conditions selected for the mobile electrostatic precipitator were intended to include typical operating conditions for full scale installations as near as was practical. A comparision between these conditions for the pilot unit and the majority of field installations are given below in Table I.

It is to be noted that the only significant departure from full scale conditions lies in the electrical sectionalization. It is impractical to duplicate this parameter in pilot units because of size and weight requirements. This departure from comparable conditions generally leads to the ability to operate the pilot unit at voltages and average current densities that are somewhat greater in the pilot unit than is possible in a comparable full scale unit. This factor places a constraint on the permissible operating conditions for the pilot unit when attempting to simulate full scale behavior.

A second departure from full scale conditions is related to gas sneakage past electrified regions. It is difficult to estimate the amount by which this differs between pilot and full scale devices. In general, the relative quantity of dust laden gas that bypasses the electrified region is significantly greater in pilot scale devices than in full scale units. Care was exercised in the design of the pilot scale unit to minimize the effect of gas sneakage.

TABLE I

COMPARISON OF PILOT AND FULL SCALE

E.S.P. PARAMETERS

ITEM	PILOT	FULL SCALE
Specific collection area M^2sec/M^3	20-100	20-150
Wire to plate spacing - cm	13	10-15
Wire to wire spacing - cm	18	10-30
Electrical fields in direction of gas flow	2-5	2-12
Gas velocity M/sec	0.5-2.0	1-2.5
Current density nA/cm^2	5-100	5-80
Plate area per T.R. Set M^2	9	50-750

The mobile E.S.P. and laboratory vans were delivered to the Environmental Protection Agency for final checkout. Tests were conducted to verify the performance of the delivered items. The results of these tests and a discussion of the design of the mobile unit were discussed in a paper[1] given in an E.P.A. sponsored symposium in Denver, Colorado, "Particulate Collection Problems Using Electrostatic Precipitators in the Metallurgical Industry."

Southern Research Institute provided the Environmental Protection Agency with a suggested measurement program and sampling port requirements as a part of this contract. The items required to be measured in the mobile pilot scale precipitator are described below. It is desirable to provide sufficient sampling ports such that all measurements can be made simultaneously. The sampling locations for mass loading and particle size distribution measurement should be in a region where a reasonably uniform gas velocity distribution exists. The other measurements may be made in regions of non-uniform flow without significantly deleterious effects. The following measurements must be made at both the inlet and outlet breechings to the precipitator:

1. Mass loading
2. Particle size 0.3 μm and greater
3. Particle size 0.5 μm and smaller
4. Gas velocity and temperature distribution (can use mass and/or particle size ports)
5. Isokinetic ash sample (dry collection)
6. Particulate resistivity
7. Gas composition
8. Operating temperature

The mass loadings should be made with an EPA Method 5 apparatus. It is desirable to provide for a permanent installation for the control console with semi-permanent sampling rails to support the sampling case and probe.

The sampling ports for the impactors and fine particle sampling should be located at a point that provides for a minimum of interference with the mass train sampling equipment.

The gas velocity distribution can be measured in the sampling points provided for the mass train and size distribution measurements.

Footnote 1. Brumfield, J.L. and Crowson, Fred. "Design and Fabrication of a Mobile Electrostatic Precipitator." Paper #11, Proceedings: Particulate Collection Problems Using ESP's in the Mettalurgical Industry EPA-600/2-77-208, Oct. 1977

The sampling points for isokinetic dry ash samples, particulate resistivity, and gas composition can be located at almost any point, since the gas velocity distribution, turbulence, and gas velocity are not critical to these measurements. The dry isokinetic ash collection is necessary for providing a sample of ash for chemical analysis and laboratory resistivity measurements. Since the Method 5 system utilizes washings and dry filter collection, the dry sample is required. The gas composition sampling point is not critical since the high diffusivity gas components readily maintain good mixing throughout the ducts.

A temperature measurement should be provided in both the inlet and outlet duct with recording capability. These measurements provide information about the stability of the source as well as giving an indication of any gas leakage into the precipitator.

A total gas volume measurement on the outlet duct or stack is desirable because it does not include errors inherent in the velocity traverses. A venturi type meter or a calibrated orifice with pressure drop readout is recommended.

It is also necessary to provide ready access to the secondary voltage and current readings from the precipitator power supplies. These readings should be recorded at regular intervals during the test period.

A follow-up to the initial recommendations were submitted as a report to the Environmental Protection Agency on November 24, 1976. This report described a test plan that should serve to both evaluate the performance of the mobile E.S.P. as well as answer some specific questions about the performance of an electrostatic precipitator experiencing some difficulties in operation. This particular field test was not conducted because of some contractual problems between the utility and the E.S.P. supplier.

This test program included base line tests with the normal coal and a test to evaluate the addition of sodium carbonate to improve the performance. The test program summarized below does not include the tests to evaluate the sodium conditioning but rather represents a two week's test period to evaluate the pilot E.S.P.

The two weeks of field tests were designed to characterize the behavior of the E.S.P. pilot plant under actual field test conditions. This includes tests over a range of gas velocities (SCA's) and a range of applied voltages and current densities.

In each field test condition, coal samples, inlet and hopper fly ash samples, Orsat and sulfur oxide samples, and representative impactor substrate samples should be preserved for later analysis.

Flue gas temperatures and flow rates should be recorded together with individual power supply readings.

The electrostatic precipitator tests recommended are as follows:

TABLE II

MOBILE PILOT ELECTROSTATIC PRECIPITATOR
SHAKEDOWN TESTS NERC LABORATORIES

Pretest

Day 1.	Calibrate power supply meters. Prepare gas velocity distribution sampling access.
2-3.	Gas velocity distribution inlet, Field 1, inlet; Field 5, outlet
4.	Volt-ampere curves - cold gas - hot gas no particulate
5.	Make-up day and determine range of velocities available.

Particulate tests - two weeks - two tests at each condition

Current density, na/cm^2	15, 40, 15 with high resistivity
Gas velocity, m/sec	0.6, 1.0
Specific collection area $ft^2/kcfm$	400, 240

Note: The above tests should be conducted at a temperature on the order of 140-160°C (280-300°F).

TABLE III

MOBILE ELECTROSTATIC PRECIPITATOR TESTS

Day 1-2

Connect unit to access port
Check electrical supply
Check meters and instrumentation
Obtain V-I curves - cold gas
Operate fan
Run hot gas V-I curves
Check mass load in pilot with main duct single point
Check gas temperature-pilot with main duct
Measure gas velocity distribution - inlet and outlet
Inspect through view ports

Day 3

Stabilize system at flue gas operating temperature
Set gas velocity
Obtain V-I curves
Select operating points for tests
Select run times and sampling rates
Run one complete test
Mass loadings - inlet and outlet
Impactors - inlet and outlet
Resistivity
Gas analysis

Day 4

Obtain two complete tests - gas velocity 1.5 m/sec (5 fps)
S.C.A. = 160 ft^2/kcfm - maximum current density
Select run times and sampling rates
Mass loadings, inlet and outlet
Impactors, inlet and outlet
Resistivity
Gas analysis
Optical density
Ash and coal samples

Day 5

Repeat Day 4. With current density set at maximum for the inlet field in all sets

Day 6

Repeat Day 5 with current density set at 60% of inlet

Day 7

Reduce data and display for review. Determine if a repeat test is required.

Day 8

Conduct tests at gas velocity of 1 m/sec (SCA = 240)

Day 9

Repeat Day 8 at reduced current density

Day 10

Conduct tests at 0.6 m/sec (SCA) = 400)
Maximum current density

Day 11

Repeat Day 10 at reduced current density.

Southern Research Institute next prepared a Pilot Electrostatic Precipitation Operating Guide for the Environmental Protection Agency. This document is included as Appendix II of this report. This guide describes our approach to the philosophy and operational techniques necessary to conduct an effective pilot electrostatic precipitator research program.

SECTION III

FIELD EVALUATIONS

The mobile electrostatic precipitator test facility was exercised in two field tests. The first test was conducted at a stoker fired steam generation system at the State of Maryland Correctional Institution at Hagarstown, Maryland and the second at the Colstrip Power Station, Montana Power Company, Colstrip, Montana. The results of these two tests were reported to the Industrial Environmental Research Laboratory by the respective contractor-operators Monsanto Research and Aerotherm Division of Acurex.

The Maryland tests were conducted to evaluate the collectability of fly ash resulting from the combustion of a combination of pelletized refuse and coal in the stoker fired boiler. This test also served as the initial field test for the pilot E.S.P. as well as a training exercise for their operating personnel. Southern Research Institute provided assistance in developing the test plan as well as operating suggestions during the test period. The tests included a comparison between the operation of the control device while utilizing coal only and coal plus refuse. Southern Research Institute did not review this report.

The tests at Colstrip, Montana were designed to evaluate the utility of sodium carbonate injection as a means for improving the collection characterics of fly ash resulting from the combustion of Western low sulfur, low sodium coals. This test consisted of a series of base-line and conditioned tests where the electrical conditioning was provided by the injection of dry sodium carbonate into the particulate laden gas streams at temperatures well below furnace temperatures. The results of the test reported by Aerotherm Division of Acurex Corporation indicate a significant increase in the electrical conditions with a concommitant improvement in the collection efficiency of the pilot precipitator with the injection of the finely divided sodium carbonate into the gas stream.

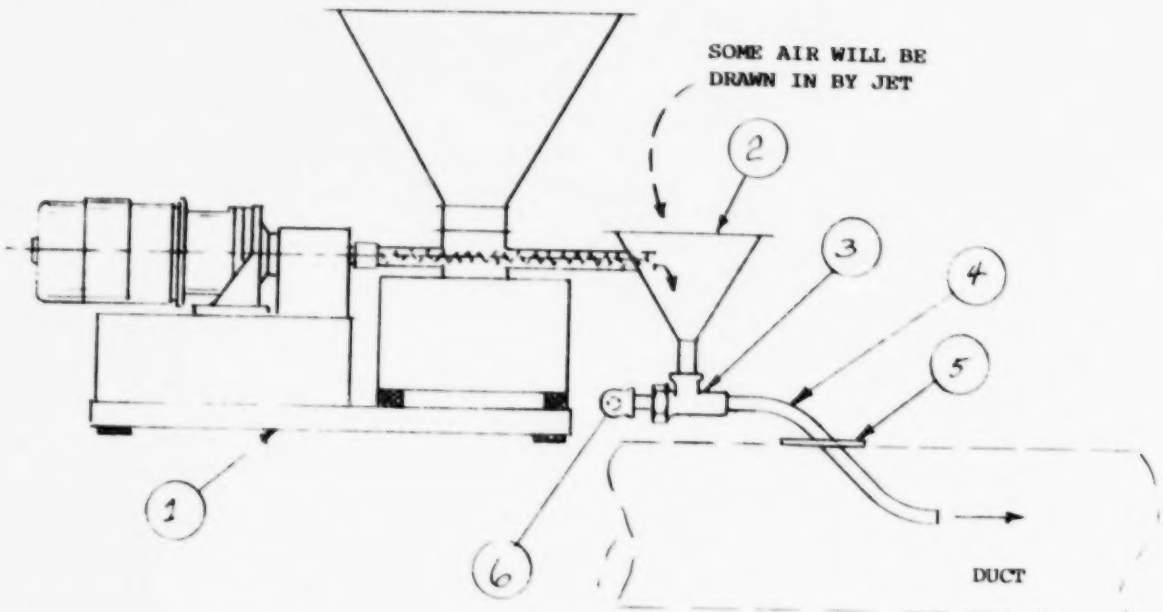
SECTION IV

DESIGN OF ADDITIONAL ITEMS

Southern Research Institute was also requested to supply designs for a sodium carbonate injection system and a 300 cfm cyclone collector with a D_{50} of five microns. These items were designed as requested. The sodium carbonate injection system was designed according to the sketch shown in Figure 1. Southern Research Institute also supplied to the Environmental Protection Agency a material metering system, a vibra-screw feeder model SCR-20. This system was delivered to the Environmental Protection Agency for use in the shakedown tests at Raleigh-Durham and in the field test at the Colstrip Power Station.

A design for the 300 cfm cyclone was provided to the Environmental Protection Agency as shown in the sketch in Figure 2. We did no fabrication for this cyclone.

WEATHER PROTECTION REQUIRED



1. VIBRASCREW FEEDER SCR-20, 3/8 SCREW, 0 - 0.1 CFH
2. FABRICATED CONNECTION BETWEEN FEEDER & INJECTOR
3. JET INJECTOR, McMASTER-CARR - P.O. BOX 4355, CHICAGO , CAT. 4977K-11
4. FABRICATED PIPE
5. COVER PLATE APPROX. 6" DIAM., WELDED TO BENT PIPE
6. COMPRESSED AIR SUPPLY LINE, APPROX. 100 PSIG

Figure 1. Sodium carbonate injection system for E.P.A. pilot E.S.P.

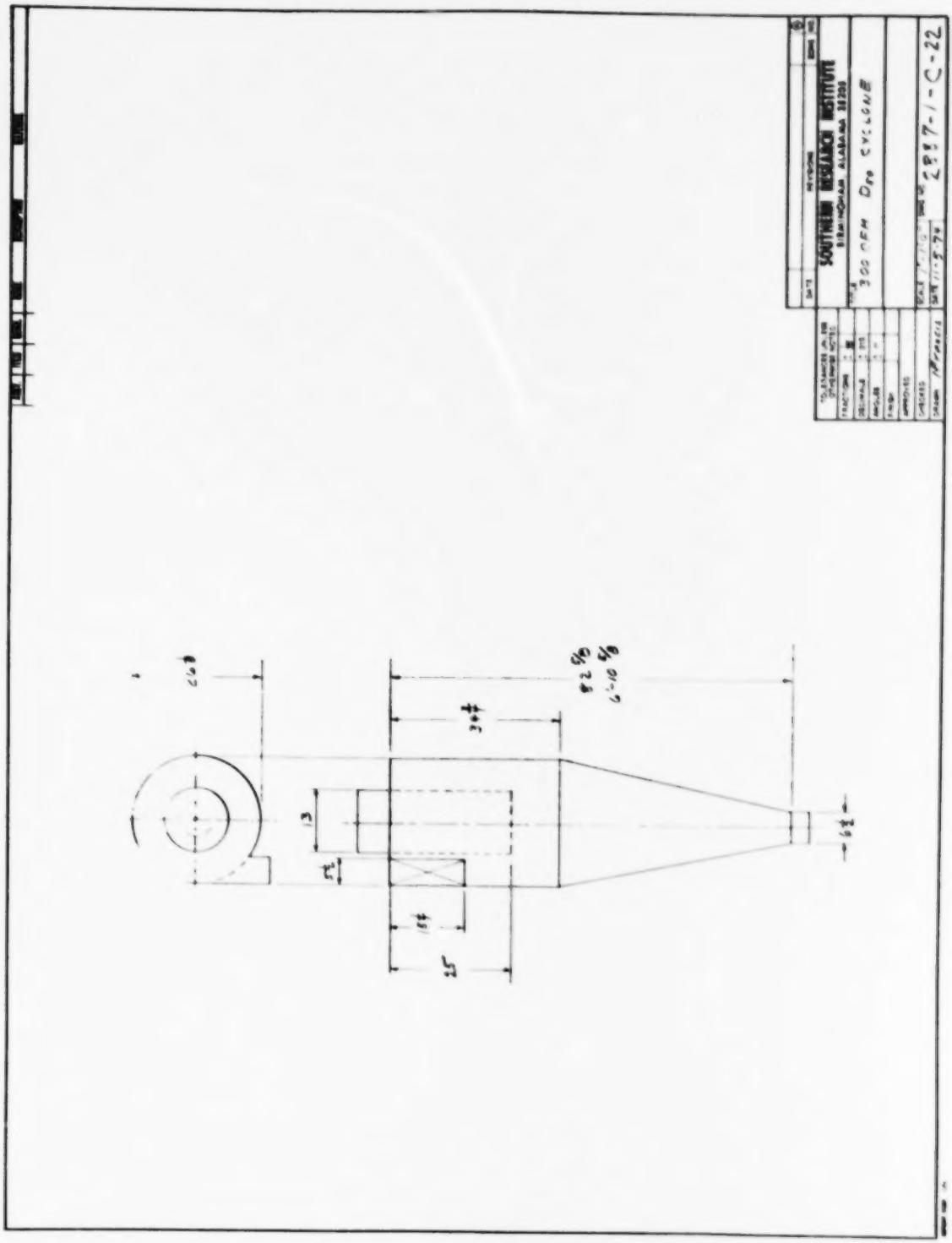


Figure 2. 300 cfm cyclone with a D_{50} of 5 microns.

APPENDIX I

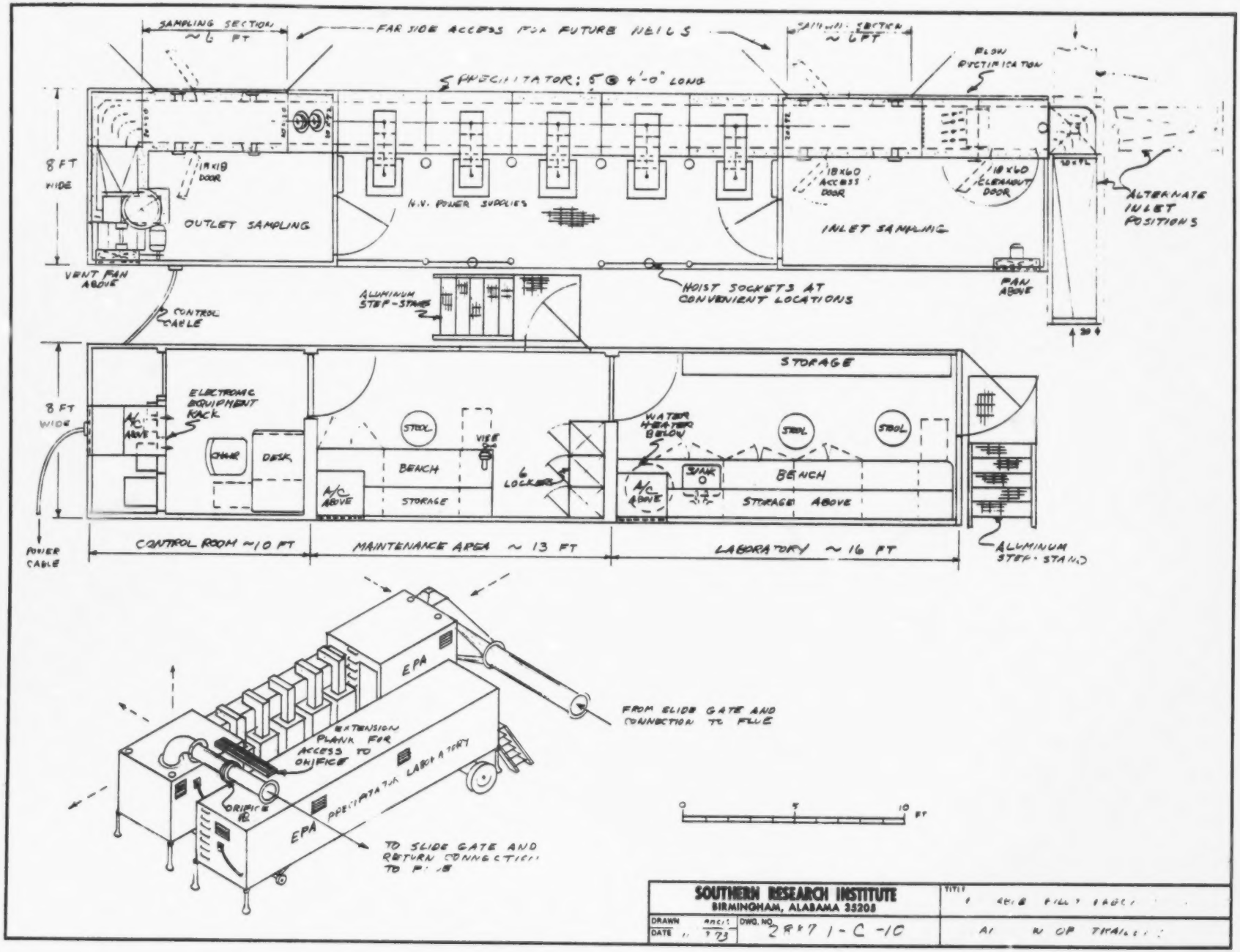
Design Drawings For Use

by

NAVAL SURFACE WEAPONS CENTER

for the

MOBILE ELECTROSTATIC PRECIPITATOR



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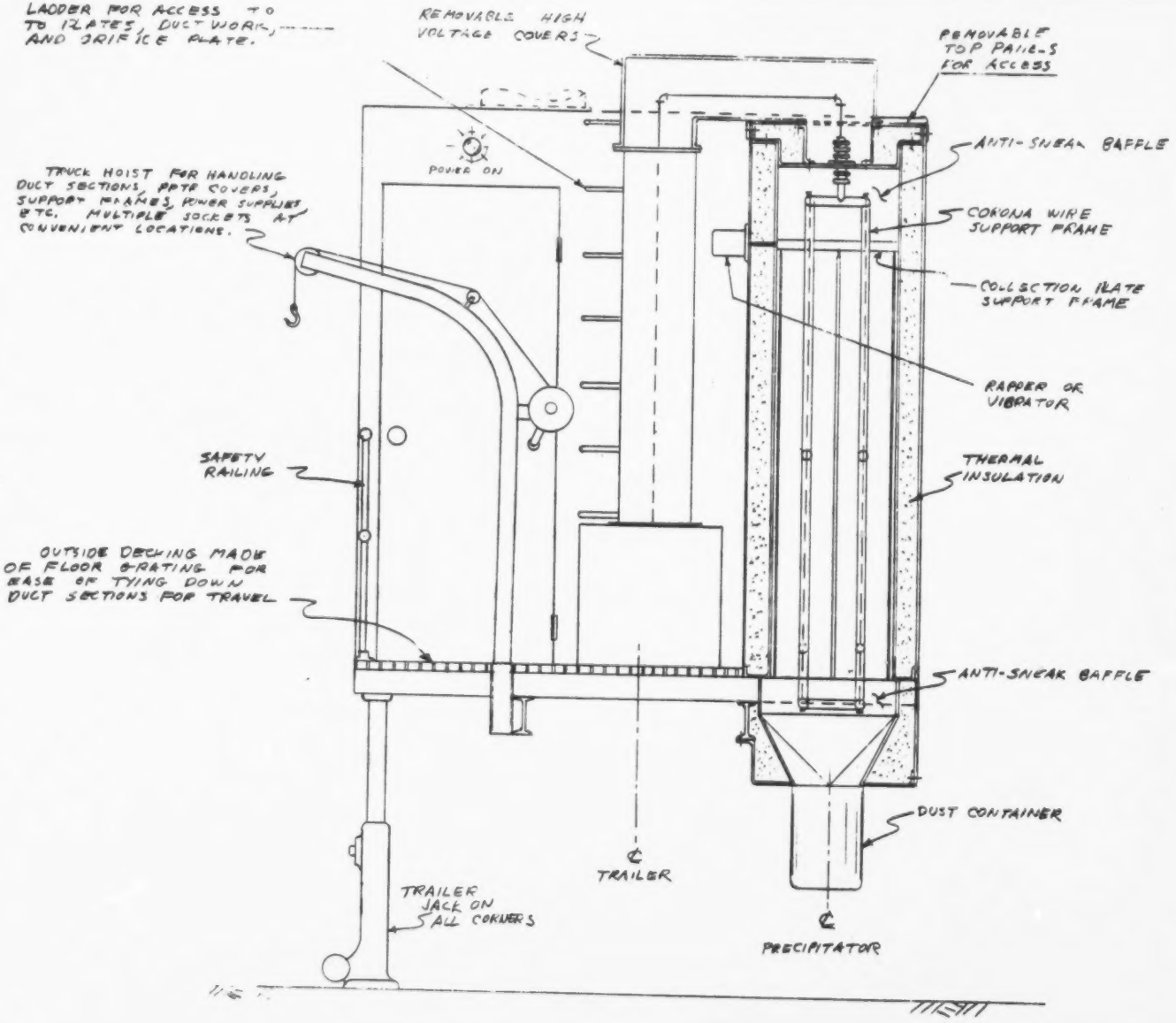
LADDER FOR ACCESS TO TO PLATES, DUCT WORK, AND ORIFICE PLATE.
REMOVABLE HIGH VOLTAGE COVERS
REMOVABLE TOP PANELS FOR ACCESS
POWER ON
ANTI-SNEAK BAFFLE
TRUCK HOIST FOR HANDLING DUCT SECTIONS, PPTR COVERS, SUPPORT FRAMES, RINER SUPPLIES ETC. MULTIPLE SOCKETS AT CONVENIENT LOCATIONS.
CORONA WIRE SUPPORT FRAME
COLLECTION PLATE SUPPORT FRAME
RAPPER OR VIBRATOR
SAFETY RAILING
THERMAL INSULATION
OUTSIDE DECKING MADE OF FLOOR GRATING FOR EASE OF TYING DOWN DUCT SECTIONS FOR TRAVEL
ANTI-SNEAK BAFFLE
DUST CONTAINER
℄ TRAILER
TRAILER JACK ON ALL CORNERS
℄ PRECIPITATOR
WEST

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE PORTABLE PILOT PRECIPITATOR
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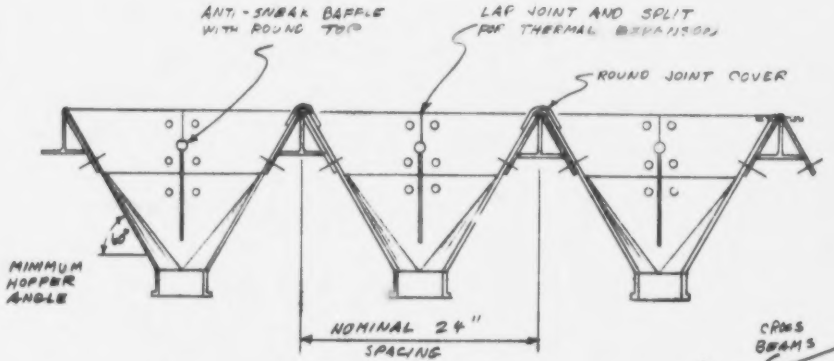
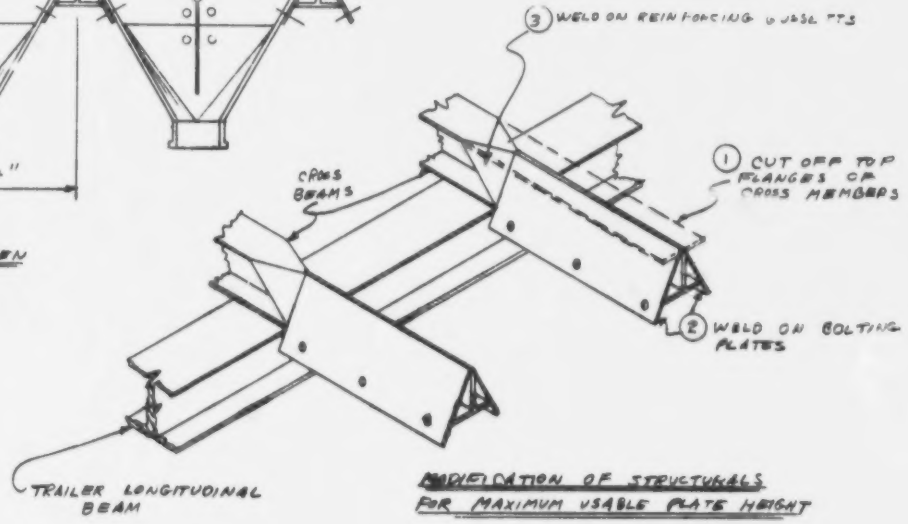

ANTI-SNEAK BAFFLE WITH ROUND TOP
LAP JOINT AND SPLIT FOR THERMAL EXPANSION
ROUND JOINT COVER
MINIMUM HOPPER ANGLE
NOMINAL 24" SPACING

DETAIL OF HOPPERS BETWEEN TRAILER STRUCTURALS


3 WELD ON REINFORCING GUSSETS
1 CUT OFF TOP FLANGES OF CROSS MEMBERS
CROSS BEAMS
2 WELD ON BOLTING PLATES
TRAILER LONGITUDINAL BEAM

MODIFICATION OF STRUCTURALS FOR MAXIMUM USABLE PLATE HEIGHT

ALTERNATE CONSTRUCTIONS WITH DIFFERENT STRUCTURAL MEMBERS AND LESS USABLE HEIGHT.

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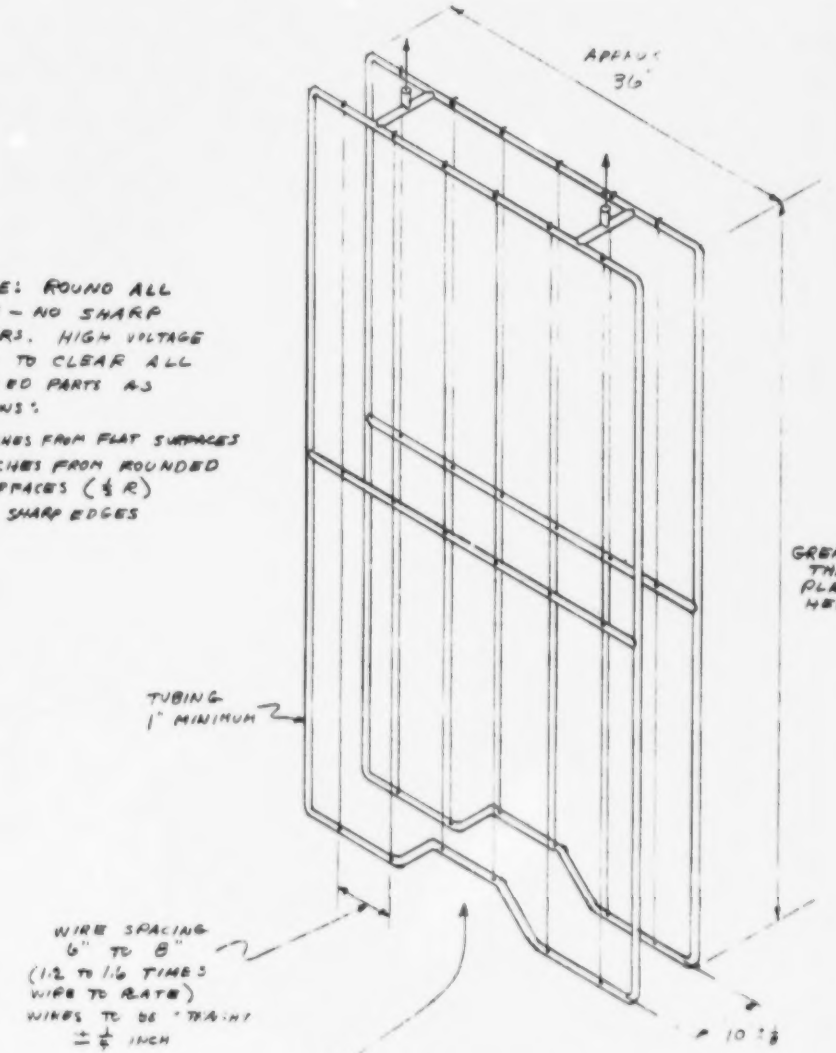
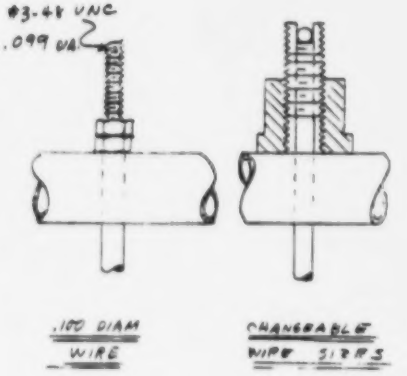
DATE: 9-11-74		


APPROX 36"
GREATER THAN PLATE HEIGHT
TUBING 1" MINIMUM
WIRE SPACING 6" TO 8" (1.2 TO 1.6 TIMES WIRE TO RATE)
WIRES TO BE "TAUGHT" ± ¼ INCH
FIGURE NEGATED TO CLEAN EDGE OF HOPPER
10"

NOTE: ROUND ALL EDGES – NO SHARP CORNERS. HIGH VOLTAGE PARTS TO CLEAR ALL GROUNDED PARTS AS FOLLOWS:

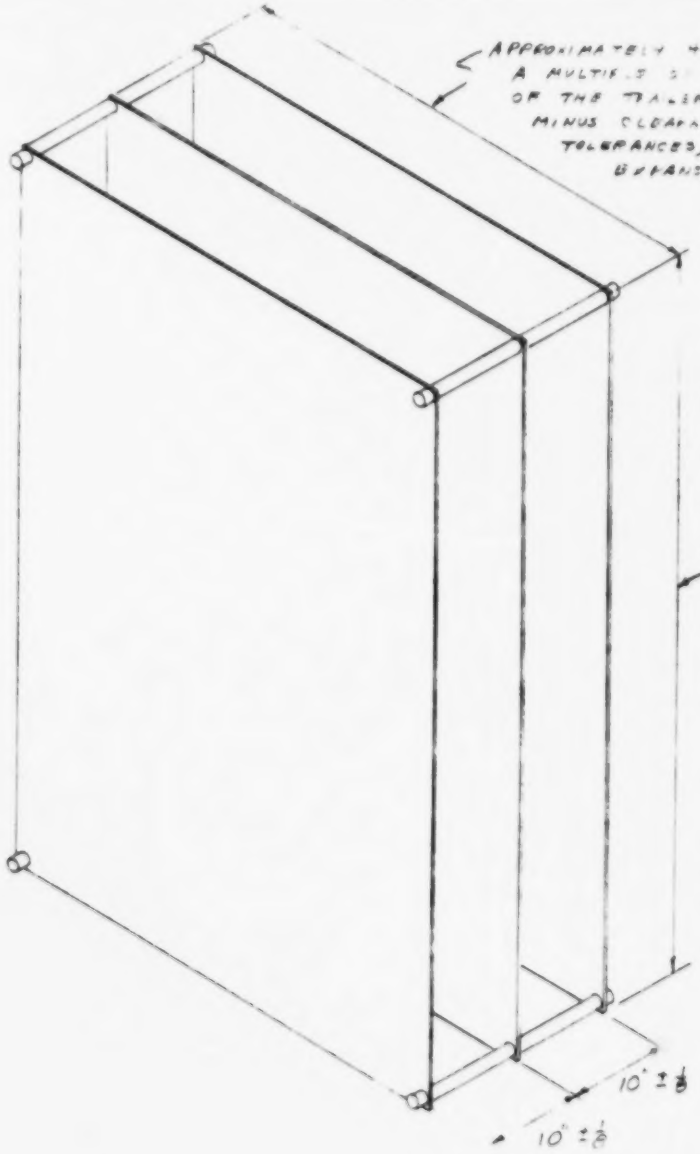
5 INCHES FROM FLAT SURFACES
8 INCHES FROM ROUNDED SURFACES (½ R)
NO SHARP EDGES

NOTE THAT CORONA WIRE FRAME IS SUSPENDED FREELY FROM TWO INSULATORS. THIS WILL REQUIRE ACCURATE LEVELLING OF THE TRAILER FOR OPERATION, BLOCKING OF THE FRAME FOR TRAVELLING, AND A SOFT MOUNT TO AVOID STRESS ON THE INSULATOR.



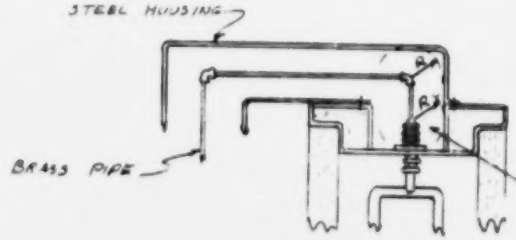
WIRE TENSIONING

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE MOBILE PILOT PRECIPITATOR
DRAWN APPROVED DATE 9-16-74 DWG NO 2877-1-C-13	CORONA WIRE SUPPORT FRAME



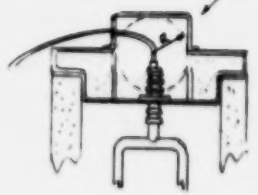
NOTE: ANY PRACTICAL DESIGN IS ACCEPTABLE; PROVIDED THERE IS A RIGID CONSTRUCTION TO SURVIVE RAPPING, A SOFT MOUNT TO ISOLATE RAPPING, AND A GOOD CONTACT TO TH RAPPER

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE: MOBILE PILOT FACILITY
DRAWN APPROVED DATE 4-16-74	DWG NO 2497-1-C-14	COLLECTION HEAT UNIT E



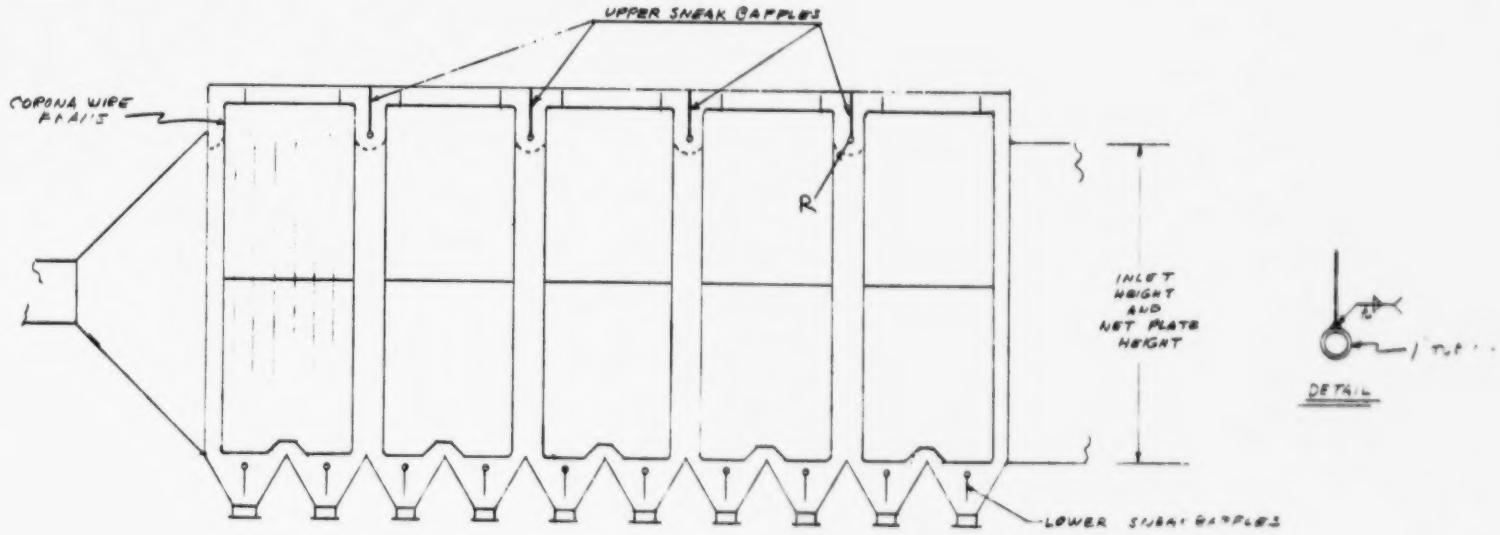
PIPE AND HOUSING HIGH VOLTAGE SUPPLY FOR RUGGEDNESS.

SPACING:
R = 5 INCHES TO FLAT SURFACES
R = 8 INCHES TO ROUNDED SURFACES ($\frac{1}{2}$ R)
NO SHARP CORNERS



FLEXIBLE HIGH VOLTAGE CABLE FOR MINIMUM SIZE REQUIREMENT

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE MDF-6 1-7 INCH PIPE
DRAWN [illegible] DATE 4-10-74	DWG. NO. 2-1/1-C-18 — IN VOLTAGE CABLE



LOCATION OF ANTI-SNEAK BAFFLES

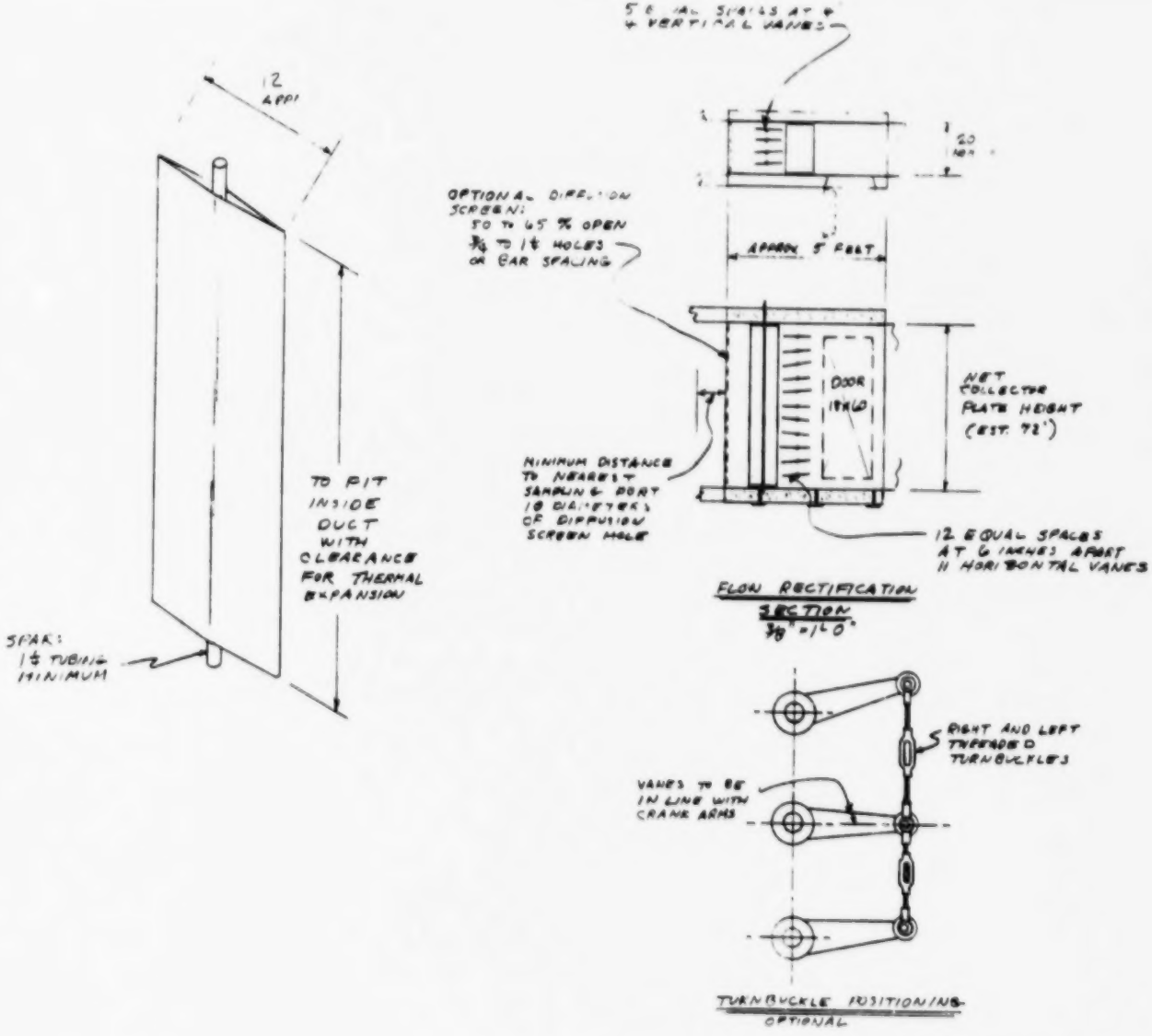
CLEARANCES:

R = 5 INCHES TO FLAT SURFACES OF OPPOSITE POLARITY

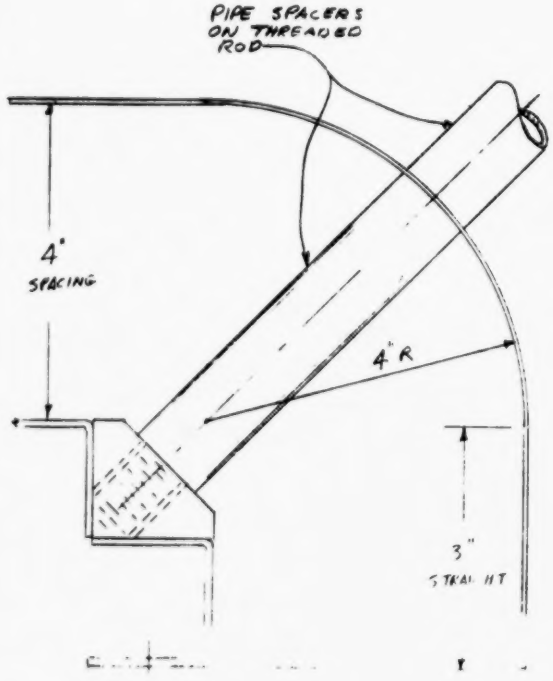
R = 8 INCHES TO ROUNDED SURFACES (4" RADIUS)

NO SHARP CORNERS

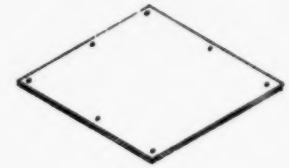
SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PILOT PLANT LIMITATION
DRAWN [illegible] DATE 4-16-74	DWG NO. 2[illegible]-C-16	ANTI-SNEAK BAFFLES


5 EQUAL SPACES AT 6 VERTICAL VANES
20 IN.
APPROX 5 FEET
OPTIONAL DIFFUSION SCREEN: 50 TO 65 % OPEN ¾ TO 1¼ HOLES OR BAR SPACING
DOOR 18X60
NET COLLECTOR PLATE HEIGHT (EST. 72')
MINIMUM DISTANCE TO NEAREST SAMPLING PORT 10 DIAMETERS OF DIFFUSION SCREEN HOLE
12 EQUAL SPACES AT 6 INCHES APART IN HORIZONTAL VANES
12 APPX
TO FIT INSIDE DUCT WITH CLEARANCE FOR THERMAL EXPANSION
SPAR: 1¼ TUBING MINIMUM
FLOW RECTIFICATION SECTION
3/8"=1'0"
RIGHT AND LEFT THREADED TURNBUCKLES
VANES TO BE IN LINE WITH CRANK ARMS
TURNBUCKLE POSITIONING OPTIONAL

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE [illegible] PRECIPITA[illegible]
DRAWN APPROVED	DWG. NO. 2487-1-C-11	FLOW RECTIFICATION SECTION
DATE 9-16-74		



DETAIL



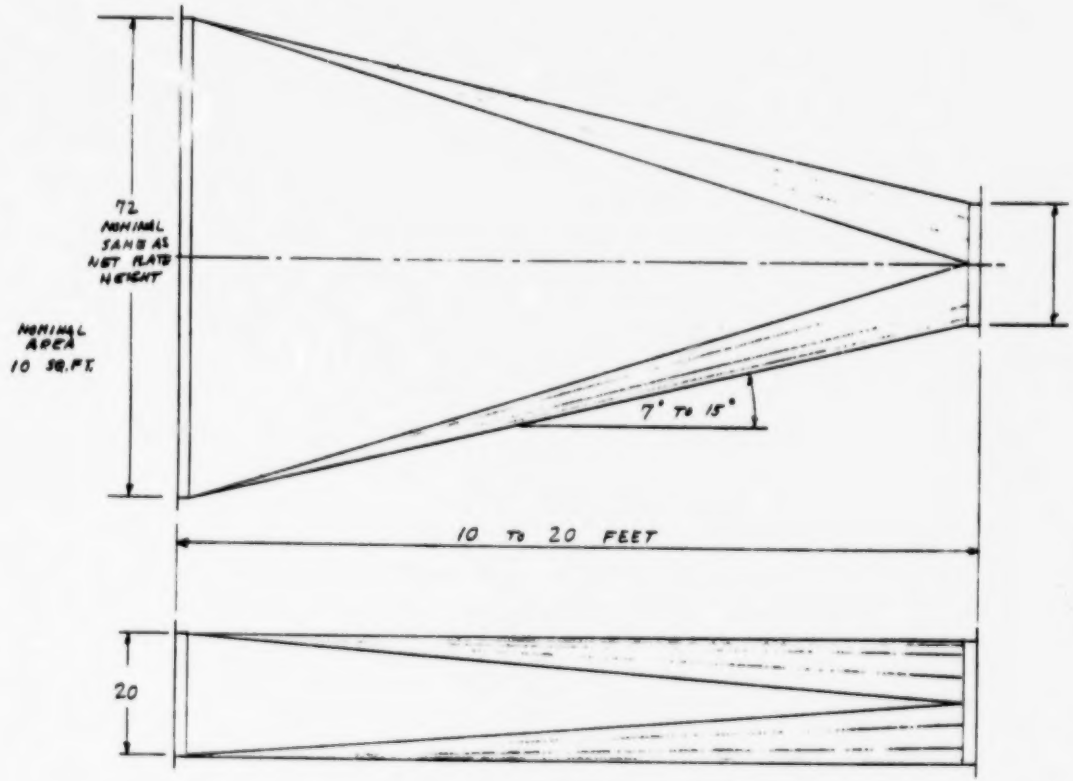
COVER

VANED ELBOW ESTIMATED LOSS 35 % VEL. PRES.

OPTIONAL BAFFLING TO CONTROL AIR FLOW IN THE HOPPER

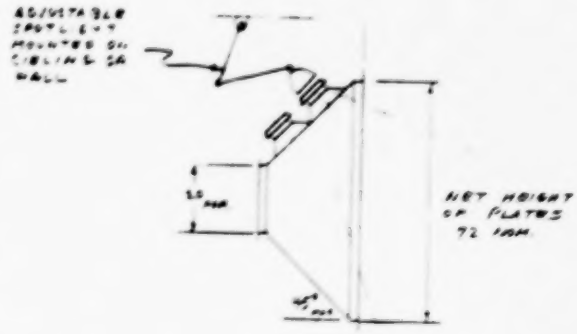
HOPPER BOTTOM WITH DOUBLE SLIDE GATES FOR CLEANOUT UNDER PRESSURE

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PILOT PLANT TO TEST
DRAWN [illegible] DATE 9-17-[illegible]	DWG. NO 2[illegible]-C-1A	REVERSIBLE VANED INLET FLOW

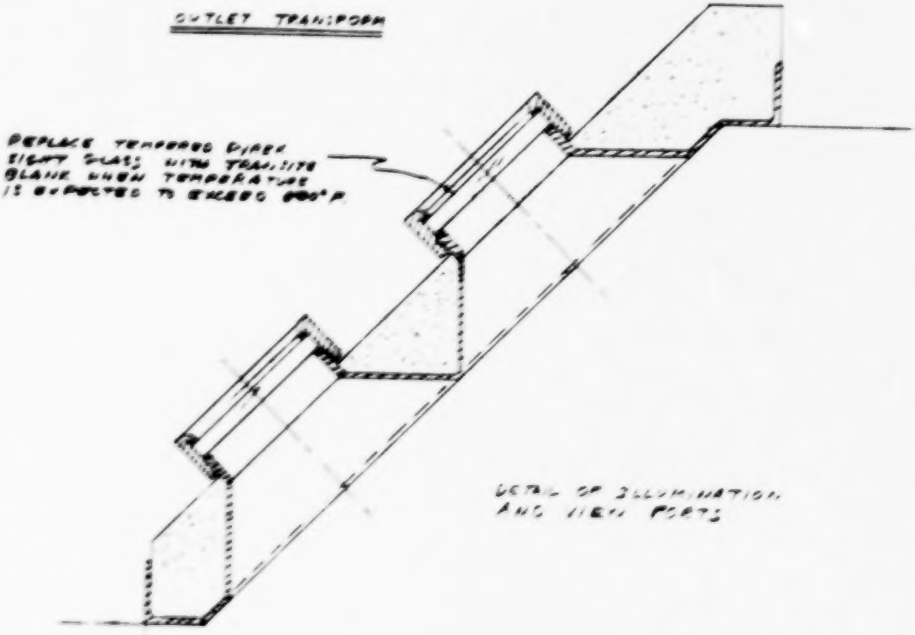


NOTE:
USE EXTREMELY LONG TRANSITION
IN ORDER TO GET SMOOTH TRANSITION
OF FLOW FROM HIGH KINETIC ENERGY
AND VELOCITY TO LOW KINETIC ENERGY
AND VELOCITY. AREA INCREASE UP
TO 8 TIMES, VELOCITY DECREASES
TO 8 TIMES, BUT KINETIC ENERGY
DECREASES 21 TO 66 TIMES DEPENDING
ON SIZE DUCTWORK CHOSEN.

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE: MOBILE PILOT PREC. TATU
DRAWN [illegible] C.L.S. DWG. NO. 2897-1-C-19 DATE 9-17-74	INLET TRANSITION



OUTLET TRANSITION



DETAIL OF ILLUMINATION AND VIEW PORTS

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		MOBILE PILOT PLANT
	2777-1-C-20	OUTLET TRANSITION

GENERAL NOTE:

IMPORTANT DIMENSIONS ARE SPECIFIED ON DRAWINGS 2877-1-C-10 THRU 20. OTHER DIMENSIONS AND DESIGN DETAILS MAY BE ALTERED FOR CONVENIENCE OF MANUFACTURE, AVAILABILITY OF MATERIALS OR FREEDOM OF DESIGN.

LABORATORY TRAILER NEEDS:

OFFICE SECTION -
- CONTROL PANEL
- DESK/TABLE WITH CHAIR
- CALCULATOR, OFFICE SUPPLIES
- FILE FOR DATA AND REFERENCES

LABORATORY SECTION -

SINK AREA: SINK WITH DRAIN
- WATER SUPPLY
- WATER HEATER

BALANCE AREA: BALANCE
- STABLE SUPPORT
- STOOL

BENCH AREA: WORK BENCH
- SHOCKPROOF GLASS STORAGE
- GLASSWARE
- LABORATORY EQUIPMENT
- 110 VAC TERMINAL STRIP
- EXPENDABLE SUPPLIES
- HOT R, STIRRERS, ETC.

MAINTENANCE AREA
- WORK BENCH, VISE, TOOLS
- LOCKERS FOR HARD HAT & WORK CLOTHES
- STORAGE FOR STAGES DURING TRAILER
- STORAGE FOR EMPTY SAMPLE CONTAINERS

GENERAL
- HEAT AND AIR CONDITIONING
- VENTILATION
- SIDE DOOR FOR DIRECT ACCESS TO OFFICE
- LIGHTS (RECESSED UNIT FOR LOW PROFILE)
- 110 VAC CONVENIENCE OUTLETS
- STEP STANDS (2)
- JACKS
- WINDOWS OPTIONAL

COMMERCIAL TOOLS

- HARLINGER TOOLS (M.A. [illegible])
  - AC/DC ARC WELDER SUPPLY COMPANY
  - PO BOX 4445 [illegible]
- CHAIN HOIST, 750 LB CAP., CAT # 32100T
- HAND TRUCK, CAT # 26 B123
- TRAILER JACKS # 3902 T 16
- MAGNETIZED UNIT LEVEL # 2164
- MAINTENANCE WORK BENCH # 6377 X 22
- LABORATORY STOOLS # 4818 R21
- EXTENSION PLANK FOR ACCESS: 9 INCHES (2 NEEDED FOR 18 FT LONG # 8446 K1
- LOCKER, DOUBLE TIER, 12 WIDE, # 6962 K26
- TRAINING FILMS, 35MM SLIDES: 3 1/2 DIA. 4 THICK # 6107 P27
- MAPPING MEDIA, MINERAL RESOURCES # 54 MD 61
- SQUARE MESH PERFORATED METAL 3/8 SQUARES 57% OPEN 18 GAUGE # 9353 X4
- TURNBUCKLES, STEEL, 3/8 BY 6 1/2 # 33 X 1
- HIGH TEMPERATURE ADHESIVE PACKED FOR LIGHT GLASSES, ALUMINUM FOIL COVERED 3 OZ # 9671
- SCHMIDT PANS FOR SAMPLING STATIONS 24" PAN WITH INLET SCREEN GUARD AND AUTOMATIC SHUTTERS # 1916 N4
- WALL LOCKER PERMANENT MOUNT # 7993 E

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SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE: MOBILE PILOT LABORATORY
DRAWN / DES. / DWG NO. / DATE	GENERAL NOTES

APPENDIX II

PILOT ELECTROSTATIC PRECIPITATOR

OPERATING GUIDE

SORI-EAS-77-040

PILOT ELECTROSTATIC PRECIPITATOR

OPERATING GUIDE

by

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Project No. 3419

EPA Project Officer: Dale Harmon

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Prepared For

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
ENVIRONMENTAL PROTECTION AGENCY
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January 18, 1977

28

PILOT ELECTROSTATIC PRECIPITATOR OPERATING GUIDE

Introduction. The operating techniques for utilizing the pilot E.S.P. will be developed as the test personnel become more familiar with the individual characteristics of the particular unit. This document was prepared as a guide for use in the early checkout and performance stages of the device.

Initial Installation and Checkout

The test location should be surveyed prior to moving the test facility to the test site. A sketch of the available space should be prepared and access ports installed. Arrangements for electrical power should be made with plant personnel. A plant contact should be established at this time.

The particulate and gas extraction ports should be located and an acceptable sample extraction nozzle designed. This design should provide for near isokinetic extraction at the mid-range of the anticipated operating volume flow rate.

In some instances, it may be desirable to provide for a sample extraction array and plenum to provide for a more representative sample extraction. In those instances where significant temperature or dust concentration variations occur within the ductwork this alternative should be considered. This plenum design may be equipped with variable cross sections for the sample extraction as a means for maintaining isokinetic sampling over an acceptable range of gas volume flow rates. This variable throat sampling need not always be provided; only in those cases where the fundamental purposes for the test program dictates the need.

The pilot electrostatic precipitator and laboratory trailers should be moved to the test site and located on the predetermined positions. The ductwork should be checked and positioned

to determine if the connections are adequate. The internals of the pilot unit should be inspected and corrected while the electrical connections and ductwork are being installed.

After the electrical connections are complete, the test facility fan should be tested. Air load voltage vs current data should be recorded and compared with previous curves. The ash removal system and other auxiliary equipment should be checked.

Initial Tests

At the completion of the installation, inspection and check-out portion, the system should be activated to pull hot particulate laden gas through the test unit. The test unit should be allowed to thermally equilibrate; after which gas velocity distributions and hot gas voltage vs current data should be recorded and analyzed.

If the gas velocity distribution is inadequate, corrections should be made to the inlet system to obtain an acceptable gas flow quality. The V-I data should be provided in order to select an operating point for the power supplies for the tests.

Initial mass, resistivity and gas analysis tests should be performed on the pilot plant. Parallel tests should generally be conducted in the main flue to assure that representative conditions exist in the test unit. These data should be evaluated prior to the initiation of the main test program.

Experimental Test Program

A test plan should be prepared for the main test program prior to moving the equipment to the test site. This test plan should be reviewed for the test crew and task assignments made. At the beginning of the field experimental program, a shake-down test should be conducted. This evaluates the adequacy of equipment, space and port allowances and smoothness of operation. At the completion of the shakedown test, the results should be compiled and the adequacy of the test plan reviewed. A daily test log should of course be maintained for the test.

The complete test program should now be conducted. It is advisable to conduct review meetings between key test personnel at intervals during the actual tests. At these times the adequacy of the tests and any required modifications to the test plan can be discussed.

At the completion of the test program, each key test person should review his data to ascertain that adequate samples have been collected and preserved. These samples should be carefully labeled and packaged for shipment. The daily test log should be reviewed prior to concluding the tests.

Equipment Preparation

The test facility should be carefully disconnected from the test site and prepared for moving to a new location. Specific packing assignments should be prepared with one person responsible for checking prior to departure.